PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-052235
(43)Date of publication of application : 22.02.2000

(51)Int.Cl. B24B 37/00
H01L 21/304

(21)Application number : 10-234995
(22)Date of filing : 06.08.1998

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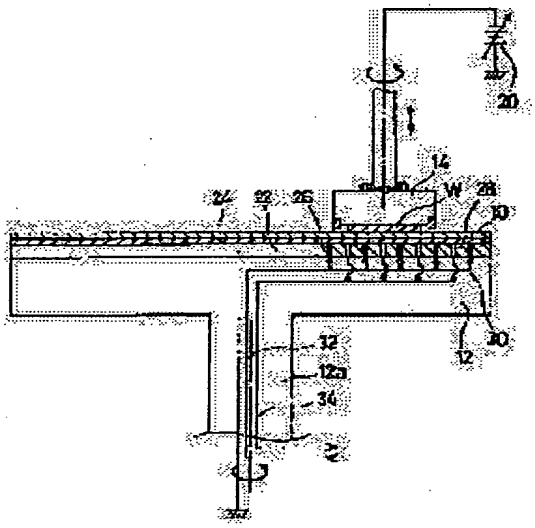
(54) POLISHING METHOD AND DEVICE THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method and the device assuring efficient polishing by reducing washing for a polished wafer and a load to drainage treatment with the use of chemicals restraining.
SOLUTION: Chemo-mechanical polishing is applied to a surface to be polished by forming a given electrical field around the surface to be polished with ultrapure water supplying between the surface to be polished of a material to be polished W and the polishing surface of a polishing member, and by sliding the surface to be polished and the polishing surface, respectively with an OH- or an H+ ion in water unevenly distributing around the surface to be polished.



* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]Supplying ultrapure water between a polished surface of an abradant, and a polished surface of a polishing member. A polishing method grinding said polished surface in chemical machinery by sliding said polished surface and said polished surface mutually, forming a predetermined electric field near said polished surface, and making underwater OH^- ion or H^+ ion unevenly distributed near said polished surface.
[Claim 2]A polishing method according to claim 1, wherein a member including a catalyst which counters said polished surface and promotes dissociation of water, and to which OH^- ion near [said] the polished surface or H^+ ion is made to increase is arranged.
[Claim 3]A polishing method according to claim 2, wherein said catalyst is an ionic exchanger.
[Claim 4]A polishing device comprising:
A polishing member which has a polished surface.
A gripping device which grasps an abradant and forces a polished surface of an abradant on said polished surface.
A transportation device which carries out relative displacement sliding said polishing member and a gripping device on said polished surface and said polished surface.
Electric field means forming which forms an electric field in which an ultrapure water feed unit which supplies ultrapure water between a polished surface of said polishing member and a polished surface of said polishing member, underwater OH^- ion near said polished surface, or H^+ ion is made unevenly distributed.

[Claim 5]Abrasive tools comprising:
A tool attachment board.
A catalyst which promotes dissociation of water attached to a clamp face of this tool attachment board.
a polishing member of this dissociation promotion member which is alike on the other hand and is attached.
An energizing means energized to said tool attachment board.

[Claim 6]A polishing member which is a polishing member which grinds an abradant by contacting an abradant when grinding, and said at least a part of polishing member contains an ionic exchanger, or is characterized by being formed for a raw material which has the water permeability which consists of ionic exchangers.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]Especially this invention relates to the polishing method and device which are used for grinding abradants, such as a semiconductor wafer, metal, and ceramics, to flatness and mirror finished surface form about the polishing method and a device.
[0002]
[Description of the Prior Art]Wiring of a circuit carries out minuteness making as high integration of a semiconductor device progresses in recent years, and inter wiring distances are also becoming narrower. Since the depth of focus becomes shallow in connection with this when performing circuit formation by optical lithography etc., the higher display flatness of the image formation face of a stepper is needed. The polishing table 12 which stuck the abrasive cloth (abrasive cloth) 10 on the upper surface as it was considered as the means which carries out flattening of the surface of a semiconductor wafer and was shown in drawing 5, The chemicals and the mechanical polish device possessing the top ring 14 forced on the polishing table 12 (CMP) are used holding the substrate (semiconductor wafer) W.
[0003]In the polish device of such composition, the substrate W is held on the undersurface of the top ring 14, and it presses in a rise-and-fall cylinder to the abrasive cloth 10 of the upper surface of the polishing table 12 turning around the substrate W. On the other hand, by passing the polish abrasive liquid Q from the polish abrasive liquid nozzle 16, the polish abrasive liquid Q is held at the abrasive cloth 10, and polish is performed in the state where the polish abrasive liquid Q exists between the field (undersurface) where the substrate W is ground, and the abrasive cloth 10. As a slurry, when grinding a silicon wafer, for example, what distributed the particles of silica, etc. is used into the chemical solution which adjusted pH by KOH etc.
[0004]
[Problem(s) to be Solved by the Invention]however, in the above-mentioned Prior art, post-washing of the wafer after polish must fully be performed, or technical problems, like the load for effluent processing of a slurry and a penetrant remover is large occurred.
[0005]Controlling chemical use, the load of washing of the wafer after polish or effluent processing is decreased, and an object of this invention is to provide the method and device which grind efficiently.
[0006]
[Means for Solving the Problem]The invention according to claim 1 supplying ultrapure water between a polished surface of an abradant, and a polished surface of a polishing member. By sliding said polished surface and said polished surface mutually, it is the polishing method grinding said polished surface in chemical machinery, forming a predetermined electric field near said polished surface, and making underwater OH^- ion or H^+ ion unevenly distributed near said polished surface.
[0007]Chemicals and mechanical polish can be performed without making OH^- ion in ultrapure water, or H^+ ion unevenly distributed near said polished surface, and using a chemical by this.
[0008]The invention according to claim 2 is the polishing method according to claim 1, wherein a member including a catalyst which counters said polished surface and promotes dissociation of water, and to which OH^- ion near [said] the polished surface or H^+ ion is made to increase is arranged. A raw material which contains an ion-exchange membrane and an ionic exchanger like an ionic exchange nonwoven fabric as a member including such a catalyst, and a raw material which consists of ionic exchangers are preferred. A catalyst which promotes dissociation of water here is a dissociation promotion member of water with an operation which makes ion increase, without soiling ultrapure water.
[0009]The invention according to claim 3 is the polishing method according to claim 2 that said catalyst is characterized by being an ionic exchanger.
[0010]It may be made to form for a raw material which has the water permeability which contains an ionic exchanger or consists of ionic exchangers in at least a part of polishing member. For example, may constitute a polishing member from an ion-exchange membrane and a usual polishing pad, and. It may be made to promote an ion maldistribution-ized operation of an ion-exchange membrane further by forming for a raw material containing an ionic exchanger like an ionic exchanger nonwoven fabric, or a raw material which consists of ionic exchangers, or attaching an ionic exchanger nonwoven fabric on an ion-exchange membrane. Since such a raw material improves the mobility of ion in a polishing member, it can reduce voltage required for movement of ion substantially. Since an

ionic exchanger nonwoven fabric has a function in which itself holds OH^- ion or H^+ ion, it also has the operation which maintains ion which was unevenly distributed near the abrasive surface, and raises processing speed.

[0011]A gripping device which the invention according to claim 4 grasps a polishing member which has a polished surface, and an abradant, and forces a polished surface of an abradant on said polished surface, A transportation device which carries out relative displacement sliding said polishing member and a gripping device on said polished surface and said polished surface, It is a polishing device having the electric field means forming which forms an electric field in which an ultrapure water feed unit which supplies ultrapure water between a polished surface of said polishing member and a polished surface of said polishing member, underwater OH^- ion near said polished surface, or H^+ ion is made unevenly distributed.

[0012]the inventions according to claim 5 are abrasive tools having a tool attachment board, a catalyst which promotes dissociation of water attached to a clamp face of this tool attachment board, a polishing member of this dissociation promotion member which is alike on the other hand and is attached, and an energizing means energized to said tool attachment board.

[0013]The invention according to claim 6 is a polishing member which grinds an abradant by contacting an abradant when grinding, said at least a part of polishing member contains an ionic exchanger, or it is the polishing member currently forming for a raw material which has the water permeability which consists of ionic exchangers. As such a raw material, an ionic exchanger nonwoven fabric produced by fibrous by methods, such as graft polymerization and radiation graft polymerization, is used suitably, for example.

[0014]

[Embodiment of the Invention]Hereafter, the embodiment of the polishing device concerning this invention is described based on drawing 1 thru/or drawing 4. The point that this polishing device has the turntable 12 which stuck the abrasive cloth on the surface, and the top ring (substrate holding device) 14 which countered this and has been arranged is the same as that of the conventional polishing device shown in drawing 5.

[0015]The maintaining structure which the drive made to rotate these in the level surface to the circumference of each shaft is formed in the turntable 12 and the top ring 14, and holds a substrate by methods, such as vacuum absorption, for the top ring 14 on the undersurface, The pressing mechanism which forces the polished surface-ed [bottom] of the substrate W which is an abradant on the field of the abrasive cloth 10 of the turntable 12 is established.

[0016]Between the turntable 12 and the top ring 14, DC power supply 20 which carry out load of the predetermined voltage which makes the top ring 14 side positive are formed. The wiring from the power supply 20 is connected to the surface plate 22 which forms the substrate clamp face of the top ring 14, and the tool clamp face of the turntable 12 via a slide terminal or internal wiring, respectively. The ion-exchange membrane 24 is stuck on the tool clamp face of the surface plate 22 as a catalyst which promotes dissociation of water, and the abrasive cloth 10 is further stuck on the upper surface. The polishing member comprises these ion-exchange membranes 24 and crossing 10.

[0017]As the ion-exchange membrane 24, both cation exchange membrane and anion exchange membrane can be used. As for the characteristics, such as thickness, porosity, intensity, and elasticity, although well-known arbitrary things are employable as a raw material, it is desirable to set up to allot the rear face of the abrasive cloth 10.

[0018]Unlike the thing of drawing 5, this polishing device has taken the internal water supply method which supplies grinding liquid from turntable 12 inside between the abrasive cloth 10 and the substrate W. That is, two or more water supply grooves (or hole) 26 and drains (or hole) 28 are established in the surface plate 22, and the feed water and the drain manifold 30 which is open for free passage to these feed water or drains (or hole) are formed in the rear-face side of the surface plate 22. This feed water and drain manifold 30 are connected to external feed water and drain piping via the internal passages 32 and 34, a fluid coupling, etc. which penetrate the shaft 12a, respectively.

[0019]Hereafter, the polishing process by the polishing device of this embodiment is explained. If the manifold 30 of the turntable 12 is supplied by using ultrapure water as grinding liquid from water supply piping, this grinding liquid will be supplied to the ion-exchange membrane 24 from the water supply groove of the surface plate 22, as shown in drawing 2, and will be supplied between an abrasive cloth and the polished surface of the substrate W via the abrasive cloth 10 of water permeability.

[0020]Here, if the top ring 14 impresses the predetermined voltage used as positive between the top ring 14 and the turntable 12, an electric field will be formed into grinding liquid and the H^+ ion in ultrapure water and OH^- ion will move by this. As a result, as shown in drawing 2, OH^- ion condenses near the substrate W side, and H^+ ion condenses in about 22 surface plate. The concentration of the OH^- ion near the substrate W is suitably chosen by the construction material of the substrate W, and other polishing conditions, and the concentration is adjusted by controlling power supply voltage.

[0021]Separation of such ion is promoted by existence of cation exchange membrane or anion exchange membrane. Namely, as shown in drawing 3 (a), when cation exchange membrane is used. Ionization of water is promoted and only the H^+ ion by the side of the substrate W moves to the surface plate 22 side, and as shown in drawing 3 (b), when anion exchange membrane is used, only the OH^- ion by the side of the surface plate 22 moves to the substrate W side, and it becomes easy to localize OH^- ion near the substrate W, respectively. As an example of a highly acidic ion-exchange membrane, the thing of Nafion 117 (made by Dupont) is mentioned.

[0022]The ion maldistribution-ized effect at the time of using an ion-exchange membrane in pure water, and applying predetermined voltage is shown in drawing 4 as compared with the case where it does not use. In drawing 4, platinum (Pt) was respectively used for the sample and the electrode, and the ion-exchange membrane used 200-micrometer-thick Nafion 117 (made by Dupont). As drawing 4 shows, it turns out that current flowed in many those who use an ion-exchange membrane, namely, dissociation of water has taken place mostly. When an ion exchange fiber is also used further in addition to an ion-exchange membrane, it also turns out that more current flows.
[0023]Apply predetermined voltage using an ion-exchange membrane in ultrapure water, ion is made unevenly distributed, and the result of having processed the surface of the metal (copper) board by this is shown in Table 1. While holding a fixed gap and immersing the copper samples used as the platinum electrode board used as the negative pole, and the anode here into the ultrapure water filled in the container, It is the structure which allocates cation exchange membrane (Nafion 117) between two electrodes, accommodates said whole container in a tight container, and purges the inside with Ar gas. It turns out that it can be processed by this by making ion unevenly distributed in ultrapure water using an ion-exchange membrane.
[0024]
[Table 1]

	加工条件			加工結果
	対向面積 (cm^2)	ギャップ (mm)	電流値 (mA)	被加工体積 (mm^3/A・min)
加工1	1×4.5	2	40	2.35
加工2	1×3	2	30	0.83

[0025]It grinds by rotating the top ring 14 and the turntable 12 in the level surface respectively, pushing the substrate W on the 10th page of an abrasive cloth by the top ring 14 in the state of drawing 2. Since OH^- ion has condensed by predetermined concentration near the substrate W, the silicon on the substrate W and the dissolution of silicon oxide are promoted, and chemical and mechanical grinding can attain, without performing pH adjustment by a chemical.
[0026]After many portions of the grinding liquid supplied from the water supply groove 26 are supplied to the surface of the abrasive cloth 10 as mentioned above, and they perform scouring, according to the centrifugal force accompanying rotation of the turntable 12, they flow into the peripheral side of the abrasive cloth 10, accompanying grinding waste, and disperse from an edge. Although H^+ ion condenses to the grinding liquid by the side of the rear face of the ion-exchange membrane 24, this is discharged from the water supply groove 26 and the drain 28 arranged by turns.
[0027]Since the grinding liquid in which H^+ ion condensed is neutralized with the OH^- ion contained in it by making the grinding liquid which dispersed from the turntable 12 join, there is no necessity of carrying out special processing. As mentioned above, in this chemical-and-mechanical-grinding process, since the chemical for pH adjustment is not used, the time and effort of washing of the substrate W after polish and processing of an effluent including a chemical is reduced.
[0028]Although the usual abrasive cloth used from the former may be used for the abrasive cloth 10, it is formed by this embodiment for the raw material which contains an ionic exchanger like an ionic exchange nonwoven fabric, for example, or the raw material which consists of ionic exchangers. Thereby, an ion maldistribution-ized operation of the ion-exchange membrane 24 can be promoted further, and it has a role of a catalyst which promotes dissociation of water. Ionic exchanger nonwoven fabrics are textiles containing the ionic exchanger which has a functional group of strong base nature like $-N(CH_3)_3OH$, for example, and are produced with graft polymerization method and a radiation graft polymerization method. Since such a raw material improves the mobility of the ion in a polishing member, it can reduce voltage required for movement of ion substantially. Since an ionic exchanger nonwoven fabric has a function in which itself holds OH^- ion or H^+ ion, it also has the operation which maintains the ion which was unevenly distributed near the polished surface of the substrate W, and raises processing speed.
[0029]In the above, although the abrasive cloth 10 and the ion-exchange membrane 24 were used as the different body, this may be formed in one. Since the abrasive cloth which specialized rather than this had the high functionality as a polishing member can be provided and it is not necessary to form two-layer structure on the spot, workability is also good. Not using an ion-exchange membrane, a polishing member may consist of only ionic exchanger nonwoven fabrics.
[0030]In the above, although the internal water supply method which supplies grinding liquid from the turntable 12 side is adopted and the abrasive grain is not used, the external water supply method from the grinding liquid nozzle 16 as shown in drawing 5 can also be adopted according to a polishing condition, and an abrasive grain may be used in this case. Also when using an abrasive grain, the slurry of a KOH base like before uses the thing which made abrasive grains, such as SiO_2 particles, suspended into pure water, without using. By making an abrasive grain intervene, a mechanical work is promoted and polishing speed increases.
[0031]In this case, the grinding liquid in which H^+ ion condensed may provide and drain the drain 28 to the surface

plate 22 like a previous embodiment, and it may be made to discharge it from the edge of the surface plate 22 according to a centrifugal force. In the case of the latter, the wastewater promotion slot which goes to an edge from the center of the surface plate 22 may be formed. An internal water supply method and an external water supply method may be used together.

[0032]In the above, although the example which condenses OH^- ion to the substrate side was explained, in grinding metal, such as copper interconnect, it arranges an electrode and anion exchange membrane so that H^+ ion may be condensed to the substrate side.

[0033]

[Effect of the Invention]As explained above, according to this invention, chemicals and mechanical polish can be performed, without using a chemical by making the OH^- ion in ultrapure water, or H^+ ion unevenly distributed near said polished surface. Therefore, controlling chemical use, the load of washing of the wafer after polish or effluent processing can be decreased, and it can grind efficiently.

[Translation done.]

* NOTICES *

TECHNICAL FIELD

[Field of the Invention]Especially this invention relates to the polishing method and device which are used for grinding abradants, such as a semiconductor wafer, metal, and ceramics, to flatness and mirror finished surface form about the polishing method and a device.

[Translation done.]

PRIOR ART

[Description of the Prior Art]Wiring of a circuit carries out minuteness making as high integration of a semiconductor device progresses in recent years, and inter wiring distances are also becoming narrower. Since the depth of focus becomes shallow in connection with this when performing circuit formation by optical lithography etc., the higher display flatness of the image formation face of a stepper is needed. The polishing table 12 which stuck the abrasive cloth (abrasive cloth) 10 on the upper surface as it was considered as the means which carries out flattening of the surface of a semiconductor wafer and was shown in drawing 5, The chemicals and the mechanical polish device possessing the top ring 14 forced on the polishing table 12 (CMP) are used holding the substrate (semiconductor wafer) W.
[0003]In the polish device of such composition, the substrate W is held on the undersurface of the top ring 14, and it presses in a rise-and-fall cylinder to the abrasive cloth 10 of the upper surface of the polishing table 12 turning around the substrate W. On the other hand, by passing the polish abrasive liquid Q from the polish abrasive liquid nozzle 16, the polish abrasive liquid Q is held at the abrasive cloth 10, and polish is performed in the state where the polish abrasive liquid Q exists between the field (undersurface) where the substrate W is ground, and the abrasive cloth 10. As a slurry, when grinding a silicon wafer, for example, what distributed the particles of silica, etc. is used into the chemical solution which adjusted pH by KOH etc.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, the OH^- ion in ultrapure water or H^+ ion is made unevenly distributed [near said polished surface] in this invention.
Therefore, chemicals and mechanical polish can be performed, without using a chemical.
Therefore, controlling chemical use, the load of washing of the wafer after polish or effluent processing can be decreased, and it can grind efficiently.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]however, in the above-mentioned Prior art, post-washing of the wafer after polish must fully be performed, or technical problems, like the load for effluent processing of a slurry and a penetrant remover is large occurred.
[0005]Controlling chemical use, the load of washing of the wafer after polish or effluent processing is decreased, and an object of this invention is to provide the method and device which grind efficiently.

[Translation done.]

MEANS

[Means for Solving the Problem]The invention according to claim 1 supplying ultrapure water between a polished surface of an abradant, and a polished surface of a polishing member. By sliding said polished surface and said polished surface mutually, it is the polishing method grinding said polished surface in chemical machinery, forming a predetermined electric field near said polished surface, and making underwater OH^- ion or H^+ ion unevenly distributed near said polished surface.

[0007]Chemicals and mechanical polish can be performed without making OH^- ion in ultrapure water, or H^+ ion unevenly distributed near said polished surface, and using a chemical by this.

[0008]The invention according to claim 2 is the polishing method according to claim 1, wherein a member including a catalyst which counters said polished surface and promotes dissociation of water, and to which OH^- ion near [said] the polished surface or H^+ ion is made to increase is arranged. A raw material which contains an ion-exchange membrane and an ionic exchanger like an ionic exchange nonwoven fabric as a member including such a catalyst, and a raw material which consists of ionic exchangers are preferred. A catalyst which promotes dissociation of water here is a dissociation promotion member of water with an operation which makes ion increase, without soiling ultrapure water.

[0009]The invention according to claim 3 is the polishing method according to claim 2 that said catalyst is characterized by being an ionic exchanger.

[0010]It may be made to form for a raw material which has the water permeability which contains an ionic exchanger or consists of ionic exchangers in at least a part of polishing member. For example, may constitute a polishing member from an ion-exchange membrane and a usual polishing pad, and. It may be made to promote an ion maldistribution-ized operation of an ion-exchange membrane further by forming for a raw material containing an ionic exchanger like an ionic exchanger nonwoven fabric, or a raw material which consists of ionic exchangers, or attaching an ionic exchanger nonwoven fabric on an ion-exchange membrane. Since such a raw material improves the mobility of ion in a polishing member, it can reduce voltage required for movement of ion substantially. Since an ionic exchanger nonwoven fabric has a function in which itself holds OH^- ion or H^+ ion, it also has the operation which maintains ion which was unevenly distributed near the abrasive surface, and raises processing speed.

[0011]A gripping device which the invention according to claim 4 grasps a polishing member which has a polished surface, and an abradant, and forces a polished surface of an abradant on said polished surface, A transportation device which carries out relative displacement sliding said polishing member and a gripping device on said polished surface and said polished surface, It is a polishing device having the electric field means forming which forms an electric field in which an ultrapure water feed unit which supplies ultrapure water between a polished surface of said polishing member and a polished surface of said polishing member, underwater OH^- ion near said polished surface, or H^+ ion is made unevenly distributed.

[0012]the inventions according to claim 5 are abrasive tools having a tool attachment board, a catalyst which promotes dissociation of water attached to a clamp face of this tool attachment board, a polishing member of this dissociation promotion member which is alike on the other hand and is attached, and an energizing means energized to said tool attachment board.

[0013]The invention according to claim 6 is a polishing member which grinds an abradant by contacting an abradant when grinding, said at least a part of polishing member contains an ionic exchanger, or it is the polishing member currently forming for a raw material which has the water permeability which consists of ionic exchangers. As such a raw material, an ionic exchanger nonwoven fabric produced by fibrous by methods, such as graft polymerization and radiation graft polymerization, is used suitably, for example.

[0014]

[Embodiment of the Invention]Hereafter, the embodiment of the polishing device concerning this invention is described based on drawing 1 thru/or drawing 4. The point that this polishing device has the turntable 12 which stuck the abrasive cloth on the surface, and the top ring (substrate holding device) 14 which countered this and has been arranged is the same as that of the conventional polishing device shown in drawing 5.

[0015]The maintaining structure which the drive made to rotate these in the level surface to the circumference of each shaft is formed in the turntable 12 and the top ring 14, and holds a substrate by methods, such as vacuum absorption, for the top ring 14 on the undersurface, The pressing mechanism which forces the polished surface-ed [bottom] of the substrate W which is an abradant on the field of the abrasive cloth 10 of the turntable 12 is established.

[0016]Between the turntable 12 and the top ring 14, DC power supply 20 which carry out load of the predetermined voltage which makes the top ring 14 side positive are formed. The wiring from the power supply 20 is connected to the surface plate 22 which forms the substrate clamp face of the top ring 14, and the tool clamp face of the turntable 12 via a slide terminal or internal wiring, respectively. The ion-exchange membrane 24 is stuck on the tool clamp face of the surface plate 22 as a catalyst which promotes dissociation of water, and the abrasive cloth 10 is further stuck on the upper surface. The polishing member comprises these ion-exchange membranes 24 and crossing 10.
[0017]As the ion-exchange membrane 24, both cation exchange membrane and anion exchange membrane can be used. As for the characteristics, such as thickness, porosity, intensity, and elasticity, although well-known arbitrary things are employable as a raw material, it is desirable to set up to allot the rear face of the abrasive cloth 10.
[0018]Unlike the thing of drawing 5, this polishing device has taken the internal water supply method which supplies grinding liquid from turntable 12 inside between the abrasive cloth 10 and the substrate W. That is, two or more water supply grooves (or hole) 26 and drains (or hole) 28 are established in the surface plate 22, and the feed water and the drain manifold 30 which is open for free passage to these feed water or drains (or hole) are formed in the rear-face side of the surface plate 22. This feed water and drain manifold 30 are connected to external feed water and drain piping via the internal passages 32 and 34, a fluid coupling, etc. which penetrate the shaft 12a, respectively.
[0019]Hereafter, the polishing process by the polishing device of this embodiment is explained. If the manifold 30 of the turntable 12 is supplied by using ultrapure water as grinding liquid from water supply piping, this grinding liquid will be supplied to the ion-exchange membrane 24 from the water supply groove of the surface plate 22, as shown in drawing 2, and will be supplied between an abrasive cloth and the polished surface of the substrate W via the abrasive cloth 10 of water permeability.
[0020]Here, if the top ring 14 impresses the predetermined voltage used as positive between the top ring 14 and the turntable 12, an electric field will be formed into grinding liquid and the H^+ ion in ultrapure water and OH^- ion will move by this. As a result, as shown in drawing 2, OH^- ion condenses near the substrate W side, and H^+ ion condenses in about 22 surface plate. The concentration of the OH^- ion near the substrate W is suitably chosen by the construction material of the substrate W, and other polishing conditions, and the concentration is adjusted by controlling power supply voltage.
[0021]Separation of such ion is promoted by existence of cation exchange membrane or anion exchange membrane. Namely, as shown in drawing 3 (a), when cation exchange membrane is used. Ionization of water is promoted and only the H^+ ion by the side of the substrate W moves to the surface plate 22 side, and as shown in drawing 3 (b), when anion exchange membrane is used, only the OH^- ion by the side of the surface plate 22 moves to the substrate W side, and it becomes easy to localize OH^- ion near the substrate W, respectively. As an example of a highly acidic ion-exchange membrane, the thing of Nafion 117 (made by Dupont) is mentioned.
[0022]The ion maldistribution-ized effect at the time of using an ion-exchange membrane in pure water, and applying predetermined voltage is shown in drawing 4 as compared with the case where it does not use. In drawing 4, platinum (Pt) was respectively used for the sample and the electrode, and the ion-exchange membrane used 200-micrometer-thick Nafion 117 (made by Dupont). As drawing 4 shows, it turns out that current flowed in many those who use an ion-exchange membrane, namely, dissociation of water has taken place mostly. When an ion exchange fiber is also used further in addition to an ion-exchange membrane, it also turns out that more current flows.
[0023]Apply predetermined voltage using an ion-exchange membrane in ultrapure water, ion is made unevenly distributed, and the result of having processed the surface of the metal (copper) board by this is shown in Table 1. While holding a fixed gap and immersing the copper samples used as the platinum electrode board used as the negative pole, and the anode here into the ultrapure water filled in the container, It is the structure which allocates cation exchange membrane (Nafion 117) between two electrodes, accommodates said whole container in a tight container, and purges the inside with Ar gas. It turns out that it can be processed by this by making ion unevenly distributed in ultrapure water using an ion-exchange membrane.
[0024]
[Table 1]

	加工条件			加工結果
	対向面積 (cm^2)	ギャップ (mm)	電流値 (mA)	被加工体積 ($mm^3/A \cdot min$)
加工1	1×4.5	2	40	2.35
加工2	1×3	2	30	0.83

[0025]It grinds by rotating the top ring 14 and the turntable 12 in the level surface respectively, pushing the substrate W on the 10th page of an abrasive cloth by the top ring 14 in the state of drawing 2. Since OH^- ion has condensed by predetermined concentration near the substrate W, the silicon on the substrate W and the dissolution of silicon oxide are promoted, and chemical and mechanical grinding can attain, without performing pH adjustment by

a chemical.

[0026]After many portions of the grinding liquid supplied from the water supply groove 26 are supplied to the surface of the abrasive cloth 10 as mentioned above, and they perform scouring, according to the centrifugal force accompanying rotation of the turntable 12, they flow into the peripheral side of the abrasive cloth 10, accompanying grinding waste, and disperse from an edge. Although H^+ ion condenses to the grinding liquid by the side of the rear face of the ion-exchange membrane 24, this is discharged from the water supply groove 26 and the drain 28 arranged by turns.

[0027]Since the grinding liquid in which H^+ ion condensed is neutralized with the OH^- ion contained in it by making the grinding liquid which dispersed from the turntable 12 join, there is no necessity of carrying out special processing. As mentioned above, in this chemical-and-mechanical-grinding process, since the chemical for pH adjustment is not used, the time and effort of washing of the substrate W after polish and processing of an effluent including a chemical is reduced.

[0028]Although the usual abrasive cloth used from the former may be used for the abrasive cloth 10, it is formed by this embodiment for the raw material which contains an ionic exchanger like an ionic exchange nonwoven fabric, for example, or the raw material which consists of ionic exchangers. Thereby, an ion maldistribution-ized operation of the ion-exchange membrane 24 can be promoted further, and it has a role of a catalyst which promotes dissociation of water. Ionic exchanger nonwoven fabrics are textiles containing the ionic exchanger which has a functional group of strong base nature like $-N(CH_3)_3OH$, for example, and are produced with graft polymerization method and a radiation graft polymerization method. Since such a raw material improves the mobility of the ion in a polishing member, it can reduce voltage required for movement of ion substantially. Since an ionic exchanger nonwoven fabric has a function in which itself holds OH^- ion or H^+ ion, it also has the operation which maintains the ion which was unevenly distributed near the polished surface of the substrate W, and raises processing speed.

[0029]In the above, although the abrasive cloth 10 and the ion-exchange membrane 24 were used as the different body, this may be formed in one. Since the abrasive cloth which specialized rather than this had the high functionality as a polishing member can be provided and it is not necessary to form two-layer structure on the spot, workability is also good. Not using an ion-exchange membrane, a polishing member may consist of only ionic exchanger nonwoven fabrics.

[0030]In the above, although the internal water supply method which supplies grinding liquid from the turntable 12 side is adopted and the abrasive grain is not used, the external water supply method from the grinding liquid nozzle 16 as shown in drawing 5 can also be adopted according to a polishing condition, and an abrasive grain may be used in this case. Also when using an abrasive grain, the slurry of a KOH base like before uses the thing which made abrasive grains, such as SiO_2 particles, suspended into pure water, without using. By making an abrasive grain intervene, a mechanical work is promoted and polishing speed increases.

[0031]In this case, the grinding liquid in which H^+ ion condensed may provide and drain the drain 28 to the surface plate 22 like a previous embodiment, and it may be made to discharge it from the edge of the surface plate 22 according to a centrifugal force. In the case of the latter, the wastewater promotion slot which goes to an edge from the center of the surface plate 22 may be formed. An internal water supply method and an external water supply method may be used together.

[0032]In the above, although the example which condenses OH^- ion to the substrate side was explained, in grinding metal, such as copper interconnect, it arranges an electrode and anion exchange membrane so that H^+ ion may be condensed to the substrate side.

[Translation done.]

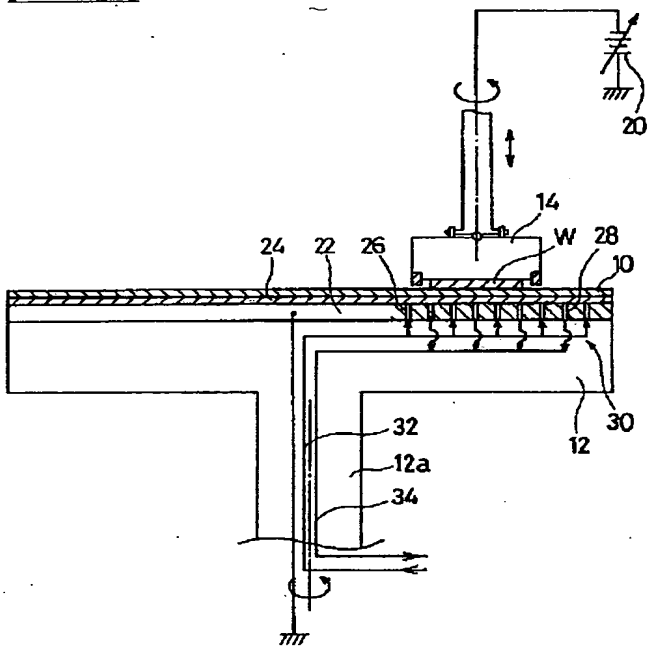
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a sectional view showing the composition of the polishing device of one embodiment of this invention.
[Drawing 2]It is a figure expanding and showing the important section of drawing 1.
[Drawing 3]It is a mimetic diagram explaining an operation of the polishing device of drawing 1.
[Drawing 4]It is a figure showing the ion maldistribution-ized effect at the time of using an ion-exchange membrane as compared with the case where it does not use.
[Drawing 5]It is a figure showing the composition of the conventional polishing device.
[Description of Notations]
10 Abrasive cloth
12 Turntable
14 Top ring
20 Power supply
22 Surface plate
24 Ion-exchange membrane
26 Water supply groove
28 Drain
30 Manifold
W Substrate (semiconductor wafer)

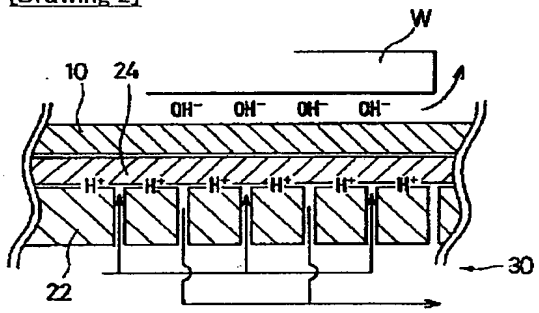
[Translation done.]

DRAWINGS

[Drawing 1]

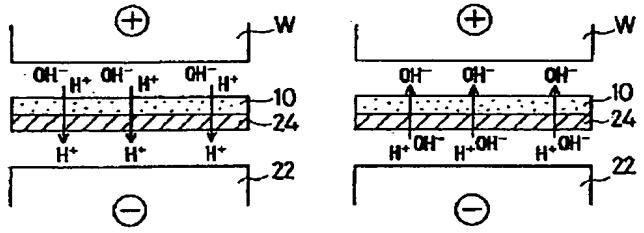


[Drawing 2]

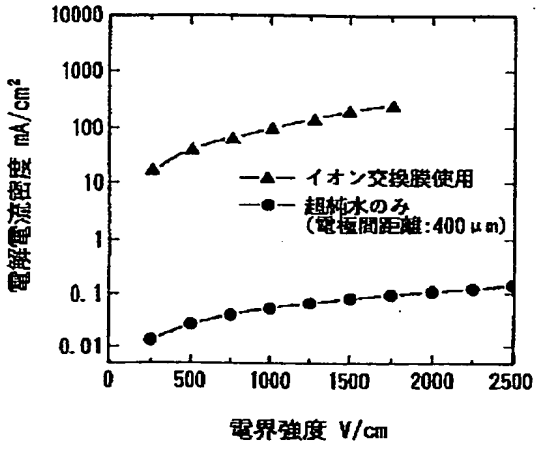


[Drawing 3]

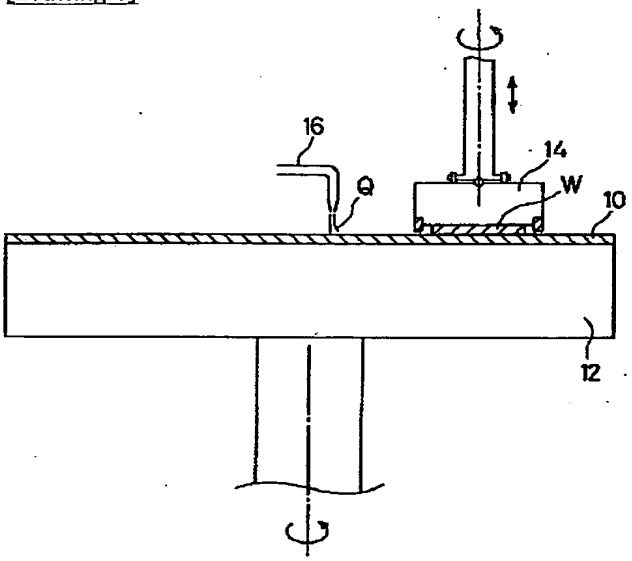
(a) (b)



[Drawing 4]



[Drawing 5]



[Translation done.]

CORRECTION OR AMENDMENT

[Kind of official gazette]Printing of amendment by the regulation of 2 of Article 17 of Patent Law
[Section classification] The 3rd classification of the part II gate
[Publication date]October 27 (2005.10.27), Heisei 17

[Publication No.]JP,2000-52235,A (P2000-52235A)
[Date of Publication]February 22, Heisei 12 (2000.2.22)
[Application number]Japanese Patent Application No. 10-234995
[The 7th edition of International Patent Classification]

B24B 37/00

H01L 21/304
[FI]

B24B 37/00 H

H01L 21/304 622 C
[Written amendment]
[Filing date]July 20, Heisei 17 (2005.7.20)
[Amendment 1]
[Document to be Amended]Specification
[Item(s) to be Amended]Claim
[Method of Amendment]Change
[The contents of amendment]
[Claim(s)]
[Claim 1]
Supplying ultrapure water between a polished surface of an abradant, and a polished surface of a polishing member. A polishing method grinding said polished surface in chemical machinery by sliding said polished surface and said polished surface mutually, forming a predetermined electric field near said polished surface, and making underwater ion unevenly distributed near said polished surface.
[Claim 2]
A polishing method according to claim 1, wherein a member including a catalyst which counters said polished surface and promotes dissociation of water, and to which ion near [said] the polished surface is made to increase is arranged.
[Claim 3]
A polishing method according to claim 2, wherein said catalyst is an ionic exchanger.
[Claim 4]
A polishing member which has a polished surface,
A gripping device which grasps an abradant and forces a polished surface of an abradant on said polished surface,
A transportation device which carries out relative displacement sliding said polishing member and a gripping device on said polished surface and said polished surface,
An ultrapure water feed unit which supplies ultrapure water between a polished surface of said polishing member, and a polished surface of said polishing member,
A polishing device having the electric field means forming which forms an electric field in which underwater ion near said polished surface is made unevenly distributed.
[Claim 5]
The polishing device according to claim 4, wherein said electric field means forming adjusts concentration of ion by controlling voltage.
[Claim 6]
Abrasive tools comprising:
A surface plate.
A catalyst which promotes dissociation of water attached to a clamp face of this surface plate.
a polishing member of this dissociation promotion member which is alike on the other hand and is attached.

An energizing means energized to said surface plate.

[Claim 7]
A polishing member which is a polishing member which grinds an abradant by contacting an abradant when grinding, and said at least a part of polishing member contains an ionic exchanger, or is characterized by being formed for a raw material which has the water permeability which consists of ionic exchangers.
[Claim 8]
A polishing member which is a polishing member which grinds an abradant and is characterized by laminating a raw material and an ion-exchange membrane containing an ionic exchanger, and constituting said polishing member.
[Claim 9]
A polishing member which a polished surface is formed and has water permeability,
A gripping device which grasps an abradant and forces a polished surface of an abradant on said polished surface,
A transportation device which carries out relative displacement sliding said polishing member and said gripping device on said polished surface and said polished surface of each other,
A grinding liquid feed unit which supplies grinding liquid to a polished surface of an abradant from said polishing member,
A polishing device having the electric field means forming which forms an electric field in which ion in grinding liquid near said polished surface is made unevenly distributed.
[Claim 10]
A polishing device of claim 9 **, wherein said grinding liquid makes pure water and an abrasive grain suspended.
[Claim 11]
A raw material in which said polishing member consists of ionic exchangers, and the polishing device according to claim 9 or 10, wherein an ion-exchange membrane is laminated.
[The amendment 2]
[Document to be Amended]Specification
[Item(s) to be Amended]0006
[Method of Amendment]Change
[The contents of amendment]
[0006]
[Means for Solving the Problem]
The invention according to claim 1 supplying ultrapure water between a polished surface of an abradant, and a polished surface of a polishing member. By sliding said polished surface and said polished surface mutually, it is the polishing method grinding said polished surface in chemical machinery, forming a predetermined electric field near said polished surface, and making underwater ion unevenly distributed near said polished surface.
[Amendment 3]
[Document to be Amended]Specification
[Item(s) to be Amended]0008
[Method of Amendment]Change
[The contents of amendment]
[0008]
The invention according to claim 2 is the polishing method according to claim 1, wherein the member including the catalyst which counters said polished surface and promotes dissociation of water, and to which the ion near [said] the polished surface is made to increase is arranged. The raw material which contains an ion-exchange membrane and an ionic exchanger like an ionic exchange nonwoven fabric as a member including such a catalyst, and the raw material which consists of ionic exchangers are preferred. The catalyst which promotes dissociation of water here is a dissociation promotion member of water with the operation which makes ion increase, without soiling ultrapure water.
[Amendment 4]
[Document to be Amended]Specification
[Item(s) to be Amended]0011
[Method of Amendment]Change
[The contents of amendment]
[0011]
A gripping device which the invention according to claim 4 grasps the polishing member which has a polished surface, and an abradant, and forces the polished surface of an abradant on said polished surface, The transportation device which carries out relative displacement sliding said polishing member and a gripping device on said polished surface and said polished surface, It is a polishing device having an ultrapure water feed unit which supplies ultrapure water between the polished surface of said polishing member, and the polished surface of said polishing member, and the electric field means forming which forms the electric field in which the underwater ion near said polished surface is made unevenly distributed.
The invention according to claim 5 is the polishing device according to claim 4, wherein said electric field means forming adjusts the concentration of ion by controlling voltage.
[Amendment 5]
[Document to be Amended]Specification
[Item(s) to be Amended]0012

[Method of Amendment]Change
[The contents of amendment]
[0012]
the inventions according to claim 6 are abrasive tools having a surface plate, a catalyst which promotes dissociation of the water attached to the clamp face of this surface plate, a polishing member of this dissociation promotion member which is alike on the other hand and is attached, and an energizing means energized to said surface plate.
[Amendment 6]
[Document to be Amended]Specification
[Item(s) to be Amended]0013
[Method of Amendment]Change
[The contents of amendment]
[0013]
The invention according to claim 7 is a polishing member which grinds an abradant by contacting an abradant when grinding, said at least a part of polishing member contains an ionic exchanger, or it is the polishing member currently forming for the raw material which has the water permeability which consists of ionic exchangers. As such a raw material, the ionic exchanger nonwoven fabric produced by fibrous by methods, such as graft polymerization and radiation graft polymerization, is used suitably, for example.
The invention according to claim 8 is a polishing member which grinds an abradant, and said polishing member is a polishing member, wherein the raw material and ion-exchange membrane containing an ionic exchanger are laminated and constituted.
The polishing member in which a polished surface is formed in and the invention according to claim 9 has water permeability, A gripping device which grasps an abradant and forces the polished surface of an abradant on said polished surface, The transportation device which carries out relative displacement sliding said polishing member and said gripping device on said polished surface and said polished surface of each other, It is a polishing device having the electric field means forming which forms the electric field in which the ion in the grinding liquid feed unit which supplies grinding liquid to the polished surface of an abradant from said polishing member, and the grinding liquid near said polished surface is made unevenly distributed.
The invention according to claim 10 is a polishing device of claim 9 **, wherein said grinding liquid makes pure water and an abrasive grain suspended.
The inventions according to claim 11 are a raw material in which said polishing member consists of ionic exchangers, and the polishing device according to claim 9 or 10 with which an ion-exchange membrane is characterized by laminating.
[Amendment 7]
[Document to be Amended]Specification
[Item(s) to be Amended]0016
[Method of Amendment]Change
[The contents of amendment]
[0016]
Between the turntable 12 and the top ring 14, DC power supply 20 which add the predetermined voltage which makes the top ring 14 side positive are formed. The wiring from the power supply 20 is connected to the surface plate 22 which forms the substrate clamp face of the top ring 14, and the tool clamp face of the turntable 12 via a slide terminal or internal wiring, respectively. The ion-exchange membrane 24 is stuck on the tool clamp face of the surface plate 22 as a catalyst which promotes dissociation of water, and the abrasive cloth 10 is further stuck on the upper surface. The polishing member comprises these ion-exchange membranes 24 and crossing 10.
[Amendment 8]
[Document to be Amended]Specification
[Item(s) to be Amended]0030
[Method of Amendment]Change
[The contents of amendment]
[0030]
In the above, although the internal water supply method which supplies grinding liquid from the turntable 12 side is adopted and the abrasive grain is not used, the external water supply method from the polish abrasive liquid nozzle 16 as shown in drawing 5 can also be adopted according to a polishing condition, and an abrasive grain may be used in this case. Also when using an abrasive grain, the slurry of a KOH base like before uses the thing which made abrasive grains, such as SiO_2 particles, suspended into pure water, without using. By making an abrasive grain intervene, a mechanical work is promoted and polishing speed increases.

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2000－52235
（P2000－52235A）
(43)公開日　平成12年２月22日(2000.2.22)

(51)Int.Cl.[7]	識別記号	Ｆ Ｉ		テーマコード（参考）
Ｂ２４Ｂ　37/00		Ｂ２４Ｂ　37/00	Ｈ	３Ｃ０５８
Ｈ０１Ｌ　21/304	６２２	Ｈ０１Ｌ　21/304	６２２Ｃ	

審査請求　未請求　請求項の数６　ＦＤ　（全　６　頁）

(21)出願番号　特願平10－234995

(22)出願日　平成10年８月６日(1998.8.6)

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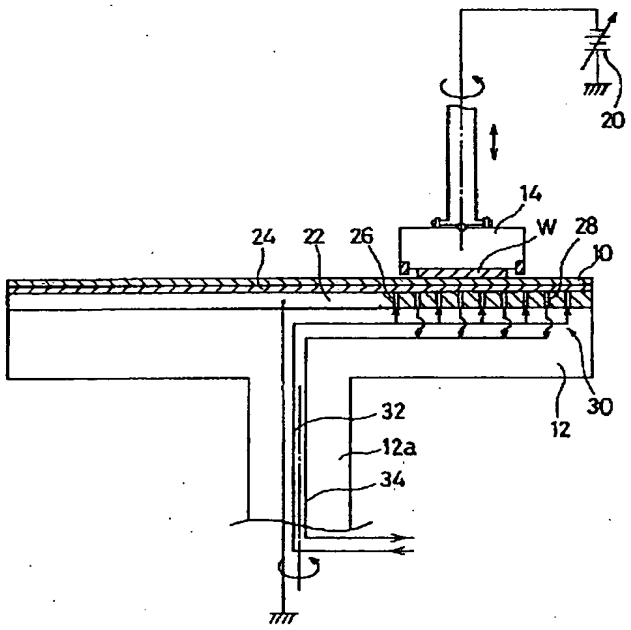
最終頁に続く

(54)【発明の名称】　ポリッシング方法及び装置

(57)【要約】
【課題】　ケミカルの使用を抑制しつつ、研磨後のウエハの洗浄や排液処理の負荷を減少させ、かつ効率的に研磨を行なう方法及び装置を提供する。
【解決手段】　被研磨材Ｗの被研磨面と研磨部材の研磨面の間に超純水を供給しつつ、被研磨面の近傍に所定の電界を形成して水中のＯＨ$^-$イオン又はＨ$^+$イオンを前記被研磨面の近傍に偏在させながら被研磨面と研磨面を互いに摺動させることにより、前記被研磨面を化学機械的に研磨する。



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【特許請求の範囲】

【請求項１】　被研磨材の被研磨面と研磨部材の研磨面の間に超純水を供給しつつ、前記被研磨面の近傍に所定の電界を形成して水中のOH⁻イオン又はH⁺イオンを前記被研磨面の近傍に偏在させながら前記被研磨面と前記研磨面を互いに摺動させることにより、前記被研磨面を化学機械的に研磨することを特徴とするポリッシング方法。

【請求項２】　前記被研磨面に対向して、水の解離を促進して前記被研磨面近傍のOH⁻イオン又はH⁺イオンを増加させる触媒を含む部材が配置されていることを特徴とする請求項１に記載のポリッシング方法。

【請求項３】　前記触媒は、イオン交換体であることを特徴とする請求項２に記載のポリッシング方法。

【請求項４】　研磨面を有する研磨部材と、
被研磨材を把持し、被研磨材の被研磨面を前記研磨面に押し付ける把持装置と、
前記研磨部材及び把持装置を前記被研磨面と前記研磨面とを摺動させつつ相対移動させる移動手段と、
前記研磨部材の研磨面及び前記被研磨部材の被研磨面の間に超純水を供給する超純水供給装置と、
前記被研磨面の近傍の水中のOH⁻イオン又はH⁺イオンを偏在させる電界を形成する電界形成手段とを有することを特徴とするポリッシング装置。

【請求項５】　工具取付盤と、該工具取付盤の取付面に取り付けられる水の解離を促進させる触媒と、該解離促進部材の他面に取り付けられる研磨部材と、前記工具取付盤に通電する通電手段とを有することを特徴とする研磨工具。

【請求項６】　研磨に際して被研磨材と接触することによって被研磨材を研磨する研磨部材であって、前記研磨部材の少なくとも一部がイオン交換体を含む又はイオン交換体からなる通水性を有する素材で形成されていることを特徴とする研磨部材。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ポリッシング方法及び装置に関し、特に、半導体ウエハ、金属、セラミックス等の被研磨材を平坦かつ鏡面状に研磨するのに用いるポリッシング方法及び装置に関するものである。

【０００２】

【従来の技術】近年、半導体デバイスの高集積化が進むにつれて回路の配線が微細化し、配線間距離もより狭くなりつつある。これに伴い、光リソグラフィなどで回路形成を行なう場合に焦点深度が浅くなるので、ステッパの結像面のより高い平坦度を必要とする。半導体ウエハの表面を平坦化する手段として、図５に示すように、上面に研磨クロス（研磨布）１０を貼り付けた研磨テーブル１２と、基板（半導体ウエハ）Ｗを保持しつつ研磨テーブル１２に押しつけるトップリング１４とを具備した

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化学・機械的研磨装置（ＣＭＰ）が用いられている。

【０００３】このような構成の研磨装置において、トップリング１４の下面に基板Ｗを保持し、基板Ｗを回転している研磨テーブル１２の上面の研磨クロス１０に昇降シリンダにより押圧する。一方、研磨砥液ノズル１６から研磨砥液Ｑを流すことにより、研磨クロス１０に研磨砥液Ｑが保持され、基板Ｗの研磨される面（下面）と研磨クロス１０の間に研磨砥液Ｑが存在する状態で研磨が行われる。スラリーとしては、例えばシリコンウエハを研磨する場合には、ＫＯＨ等でｐＨを調整したケミカル溶液中にシリカの微粒子等を分散させたものが用いられる。

【０００４】

【発明が解決しようとする課題】しかしながら、上記の従来の技術においては、研磨後のウエハの後洗浄を充分に行わなければならない、あるいは、スラリーや洗浄液の排液処理のための負荷が大きい等の課題があった。

【０００５】本発明は、ケミカルの使用を抑制しつつ、研磨後のウエハの洗浄や排液処理の負荷を減少させ、かつ効率的に研磨を行なう方法及び装置を提供することを目的とする。

【０００６】

【課題を解決するための手段】請求項１に記載の発明は、被研磨材の被研磨面と研磨部材の研磨面の間に超純水を供給しつつ、前記被研磨面の近傍に所定の電界を形成して水中のOH⁻イオン又はH⁺イオンを前記被研磨面の近傍に偏在させながら前記被研磨面と前記研磨面を互いに摺動させることにより、前記被研磨面を化学機械的に研磨することを特徴とするポリッシング方法である。

【０００７】これにより、超純水中のOH⁻イオン又はH⁺イオンを前記被研磨面の近傍に偏在させ、ケミカルを用いることなしに、化学・機械的研磨を行なうことができる。

【０００８】請求項２に記載の発明は、前記被研磨面に対向して、水の解離を促進して前記被研磨面近傍のOH⁻イオン又はH⁺イオンを増加させる触媒を含む部材が配置されていることを特徴とする請求項１に記載のポリッシング方法である。このような触媒を含む部材としては、イオン交換膜やイオン交換不織布のようなイオン交換体を含む素材や、イオン交換体からなる素材が好適である。ここで水の解離を促進する触媒とは、超純水を汚すことなくイオンを増加させる作用がある水の解離促進部材のことである。

【０００９】請求項３に記載の発明は、前記触媒が、イオン交換体であることを特徴とする請求項２に記載のポリッシング方法である。

【００１０】研磨部材の少なくとも一部を、イオン交換体を含む又はイオン交換体からなる通水性を有する素材で形成するようにしてもよい。例えば、研磨部材を、イオン交換膜と通常の研磨パッドで構成してもよいし、イ

オン交換体不織布のようなイオン交換体を含む素材やイオン交換体からなる素材で形成してもよく、もしくはイオン交換膜の上にイオン交換体不織布を取り付けることによりイオン交換膜のイオン偏在化作用をさらに助長するようにしても良い。このような素材は、研磨部材中のイオンの移動性を高めるので、イオンの移動に必要な電圧を大幅に低下させることができる。イオン交換体不織布はそれ自身がOH^-イオン又はH^+イオンを保持する機能を有するので、被研磨材面の近くに偏在したイオンを維持して処理速度を高める作用をも有する。

【００１１】請求項４に記載の発明は、研磨面を有する研磨部材と、被研磨材を把持し、被研磨材の被研磨面を前記研磨面に押し付ける把持装置と、前記研磨部材及び把持装置を前記被研磨面と前記研磨面とを摺動させつつ相対移動させる移動手段と、前記研磨部材の研磨面及び前記被研磨部材の被研磨面の間に超純水を供給する超純水供給装置と、前記被研磨面の近傍の水中のOH^-イオン又はH^+イオンを偏在させる電界を形成する電界形成手段とを有することを特徴とするポリッシング装置である。

【００１２】請求項５に記載の発明は、工具取付盤と、該工具取付盤の取付面に取り付けられる水の解離を促進させる触媒と、該解離促進部材の他面に取り付けられる研磨部材と、前記工具取付盤に通電する通電手段とを有することを特徴とする研磨工具である。

【００１３】請求項６に記載の発明は、研磨に際して被研磨材と接触することによって被研磨材を研磨する研磨部材であって、前記研磨部材の少なくとも一部がイオン交換体を含む又はイオン交換体からなる通水性を有する素材で形成されていることを特徴とする研磨部材である。このような素材としては、例えば、グラフト重合、放射線グラフト重合等の方法で繊維状に作製されたイオン交換体不織布が好適に用いられる。

【００１４】

【発明の実施の形態】以下、本発明に係るポリッシング装置の実施の形態を、図１ないし図４に基づいて説明する。このポリッシング装置は、表面に研磨クロスを貼付したターンテーブル１２と、これに対向して配置されたトップリング（基板把持装置）１４とを有する点は図５に示す従来のポリッシング装置と同様である。

【００１５】ターンテーブル１２及びトップリング１４にはこれらをそれぞれのシャフト周りに水平面内で回転させる駆動装置が設けられ、トップリング１４には真空吸着等の方法で基板を下面に保持する保持機構と、被研磨材である基板Wの下側被研磨面をターンテーブル１２の研磨クロス１０の面上に押し付ける押圧機構が設けられている。

【００１６】ターンテーブル１２とトップリング１４の間には、トップリング１４側を正とする所定の電圧を負荷する直流電源２０が設けられている。電源２０からの配線は、それぞれ摺動端子や内部配線を介してトップリング１４の基板取付面及びターンテーブル１２の工具取付面を形成する定盤２２に接続されている。定盤２２の工具取付面には、水の解離を促進する触媒としてイオン交換膜２４が貼付され、さらにその上面に研磨クロス１０が貼付されている。これらのイオン交換膜２４とクロス１０で研磨部材が構成されている。

【００１７】イオン交換膜２４としては、陽イオン交換膜、陰イオン交換膜のいずれをも用いることができる。素材としては周知の任意のものを採用することができるが、厚さ、気孔率、強度、弾性等の特性は研磨クロス１０の裏面に配するのに好適なように設定することが望ましい。

【００１８】このポリッシング装置は、図５のものと異なり、研磨クロス１０と基板Wの間に研磨液をターンテーブル１２内部から供給する内部給水方式を採っている。すなわち、定盤２２には複数の給水溝（又は孔）２６と排水溝（又は孔）２８が設けられ、定盤２２の裏面側にはこれらの給水又は排水溝（又は孔）に連通する給水・排水マニホールド３０が形成されている。この給水・排水マニホールド３０はそれぞれシャフト１２ａを貫通する内部流路３２，３４及び流体継手等を介して外部の給水・排水配管に連絡されている。

【００１９】以下、この実施の形態のポリッシング装置による研磨工程を説明する。給水配管より、超純水を研磨液としてターンテーブル１２のマニホールド３０に供給すると、この研磨液は、図２に示すように定盤２２の給水溝からイオン交換膜２４へと供給され、通水性の研磨クロス１０を介して研磨クロスと基板Wの被研磨面の間に供給される。

【００２０】ここで、トップリング１４とターンテーブル１２の間にトップリング１４が正となる所定の電圧を印加すると研磨液中に電界が形成され、これによって超純水中のH^+イオン及びOH^-イオンが移動する。この結果、図２に示すように、基板W面近傍ではOH^-イオンが濃化し、定盤２２近傍ではH^+イオンが濃化する。基板W近傍のOH^-イオンの濃度は、基板Wの材質やその他の研磨条件によって適宜選択され、その濃度は電源電圧を制御することにより調整される。

【００２１】このようなイオンの分離は、陽イオン交換膜又は陰イオン交換膜の存在によって促進される。すなわち、図３（ａ）に示すように陽イオン交換膜を用いた場合には、水のイオン化が促進され、基板W側のH^+イオンのみが定盤２２側に移動し、図３（ｂ）に示すように陰イオン交換膜を用いた場合には、定盤２２側のOH^-イオンのみが基板W側に移動し、それぞれ基板W近傍にOH^-イオンが局在化しやすくなる。なお、強酸性イオン交換膜の一例としては、ナフィオン１１７（Dupont社製）のものが挙げられる。

【００２２】図４に、純水中でイオン交換膜を用いて所

定の電圧をかけた場合のイオン偏在化効果を、用いない場合と比較して示す。図４では、試料、電極に各々白金（Ｐｔ）を用い、イオン交換膜は厚さ２００μｍのナフィオン１１７（Dupont社製）を用いた。図４から分かるように、イオン交換膜を使用した方が電流が多く流れ、即ち水の解離が多く起こっていることが分かる。また、イオン交換膜に加えてさらにイオン交換繊維をも用いた場合には、より多くの電流が流れることも分かっている。

【００２３】超純水中でイオン交換膜を用いて所定の電圧をかけてイオンを偏在させ、これによって金属（銅）＊板の表面の加工を行った結果を、表１に示す。ここでは、容器内に満たした超純水中に、陰極となる白金電極板と陽極となる銅製の試料を一定のギャップを保持して浸漬するとともに、両電極間に陽イオン交換膜（ナフィオン１１７）を配設し、前記容器の全体を気密容器内に収容して、その内部をＡｒガスでパージする構造である。これにより、超純水中でイオン交換膜を用いてイオンを偏在させることで、加工が可能であることが分かる。

【００２４】

【表１】

	加工条件			加工結果
	対向面積（cm^2）	ギャップ（mm）	電流値（mA）	被加工体積（$mm^3/A \cdot min$）
加工１	１×4.5	２	４０	２．３５
加工２	１×３	２	３０	０．８３

【００２５】図２の状態で、トップリング１４により基板Ｗを研磨クロス１０面上に押し付けながら、トップリング１４及びターンテーブル１２を各々水平面内で回転させて研磨を行なう。基板Ｗの近傍にはOH^-イオンが所定の濃度で濃化しているので、基板Ｗ上のシリコンやシリコン酸化膜の溶解が促進され、化学的・機械的研磨がケミカルによるｐＨ調整を行わずに達成できる。

【００２６】給水溝２６から供給された研磨液の多くの部分は、上述したように研磨クロス１０の表面に供給され、研磨作用を行った後にターンテーブル１２の回転に伴う遠心力によって、研磨屑を同伴しつつ研磨クロス１０の周辺側に流れ、縁部から飛散する。イオン交換膜２４の裏面側の研磨液にはH^+イオンが濃化するが、これは給水溝２６と交互に配置された排水溝２８から排出される。

【００２７】H^+イオンが濃化した研磨液は、ターンテーブル１２から飛散した研磨液と合流させることにより、それに含まれるOH^-イオンと中和してしまうので、特別な処理をする必要が無い。以上のように、この化学的・機械的研磨工程では、ｐＨ調整のためのケミカルを用いていないので、研磨後の基板Ｗの洗浄や、ケミカルを含む排液の処理の手間が軽減される。

【００２８】研磨クロス１０は、従来から用いられている通常の研磨クロスを用いても良いが、本実施の形態では、例えばイオン交換不織布のようなイオン交換体を含む素材やイオン交換体からなる素材で形成している。これにより、イオン交換膜２４のイオン偏在化作用をさらに助長することができ、水の解離を促進する触媒としての役割を有する。イオン交換体不織布は、例えば－Ｎ（CH_3）$_3$ＯＨのような強塩基性の官能基を有するイオン交換体を含む繊維であり、グラフト重合法、放射線グラフト重合法によって作製する。このような素材は、研磨部材中のイオンの移動性を高めるので、イオンの移動に必要な電圧を大幅に低下させることができる。さらに、イオン交換体不織布はそれ自身がOH^-イオン又はH^+イオンを保持する機能を有するので、基板Ｗの被研磨面近傍に偏在したイオンを維持して処理速度を高める作用をも有する。

【００２９】上記においては、研磨クロス１０とイオン交換膜２４を別体としたが、これを一体に形成してもよい。これにより、研磨部材としての高い機能性を有するより特化した研磨クロスを提供することができ、現場で２層構造を形成する必要もないので作業性も良い。また、イオン交換膜を用いず、研磨部材をイオン交換体不織布のみで構成してもよい。

【００３０】また、上記においては、研磨液をターンテーブル１２側から供給する内部給水方式を採用し、砥粒は用いていないが、図５に示すような研磨液ノズル１６からの外部給水方式も研磨条件に応じて採用することができ、この場合は砥粒を用いても良い。砥粒を用いる場合も、従来のようなＫＯＨベースのスラリーは用いずに、純水中にＳｉO_2粒子などの砥粒を懸濁させたものを用いる。砥粒を介在させることにより、機械的作用が促進され、研磨速度が増す。

【００３１】この場合、H^+イオンが濃化した研磨液は、先の実施の形態のように定盤２２に排水溝２８を設けて排水してもよく、また、遠心力により定盤２２の縁部から排出するようにしてもよい。後者の場合には、定盤２２の中心から縁部に向かう排水促進溝を形成してもよい。また、内部給水方式と外部給水方式を併用してもよい。

【００３２】なお、上記においては、OH^-イオンを基

板側に濃化させる例を説明したが、銅配線などの金属を研磨する場合には、H^+イオンを基板側に濃化させるように電極や、陰イオン交換膜を配置する。

【００３３】

【発明の効果】以上説明したように、この発明によれば、超純水中のOH^-イオン又はH^+イオンを前記被研磨面の近傍に偏在させることにより、ケミカルを用いることなしに、化学・機械的研磨を行なうことができる。従って、ケミカルの使用を抑制しつつ、研磨後のウエハの洗浄や排液処理の負荷を減少させ、かつ効率的に研磨を行なうことができる。

【図面の簡単な説明】

【図１】この発明の１つの実施の形態のポリッシング装置の構成を示す断面図である。

【図２】図１の要部を拡大して示す図である。

【図３】図１のポリッシング装置の作用を説明する模式＊図である。

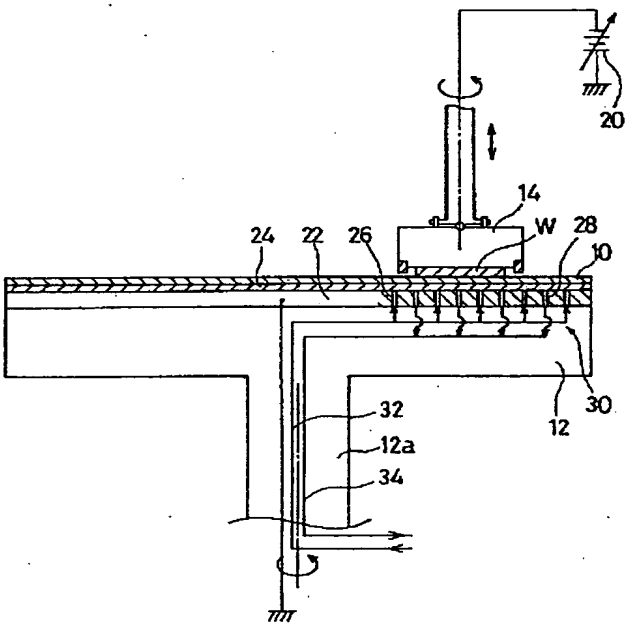
【図４】イオン交換膜を用いた場合のイオン偏在化効果を、用いない場合と比較して示す図である。

【図５】従来のポリッシング装置の構成を示す図である。

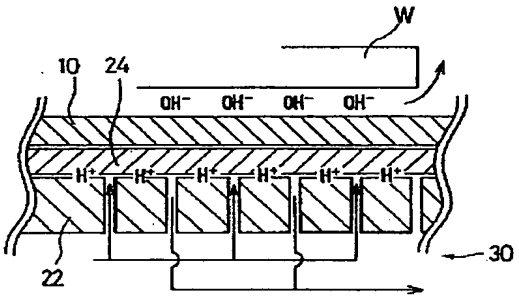
【符号の説明】

１０	研磨クロス
１２	ターンテーブル
１４	トップリング
２０	電源
２２	定盤
２４	イオン交換膜
２６	給水溝
２８	排水溝
３０	マニホールド
Ｗ	基板（半導体ウエハ）

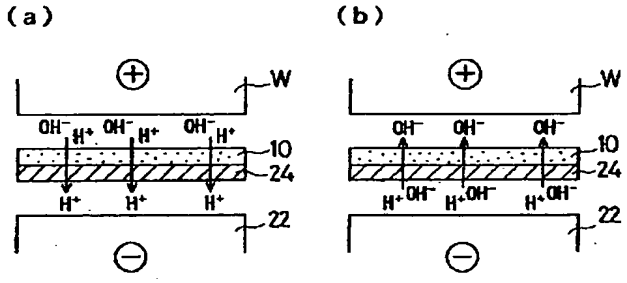
【図１】



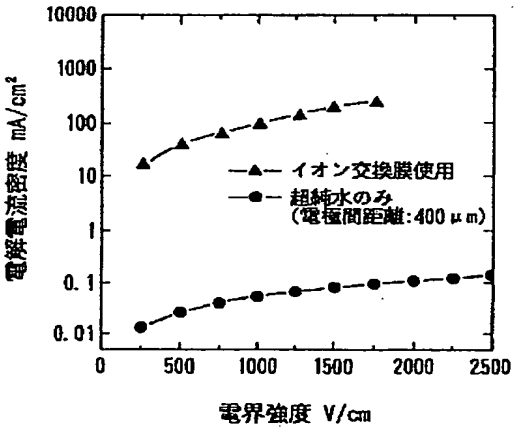
【図２】



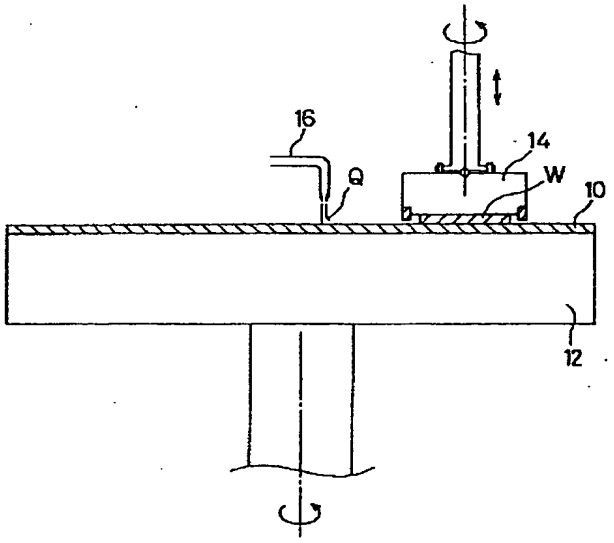
【図３】



【図４】



【図５】



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Ｆターム(参考)　3C058 AA07 AA11 AB04 AC04 CB03 DA02 DA12 DA17

【公報種別】特許法第１７条の２の規定による補正の掲載
【部門区分】第２部門第３区分
【発行日】平成17年10月27日(2005.10.27)

【公開番号】特開2000-52235(P2000-52235A)
【公開日】平成12年2月22日(2000.2.22)
【出願番号】特願平10-234995
【国際特許分類第７版】
Ｂ２４Ｂ　37/00
Ｈ０１Ｌ　21/304
【ＦＩ】
Ｂ２４Ｂ　37/00　Ｈ
Ｈ０１Ｌ　21/304　６２２Ｃ

【手続補正書】
【提出日】平成17年7月20日(2005.7.20)
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正の内容】
【特許請求の範囲】
【請求項１】
被研磨材の被研磨面と研磨部材の研磨面の間に超純水を供給しつつ、前記被研磨面の近傍に所定の電界を形成して水中のイオンを前記被研磨面の近傍に偏在させながら前記被研磨面と前記研磨面を互いに摺動させることにより、前記被研磨面を化学機械的に研磨することを特徴とするポリッシング方法。
【請求項２】
前記被研磨面に対向して、水の解離を促進して前記被研磨面近傍のイオンを増加させる触媒を含む部材が配置されていることを特徴とする請求項１に記載のポリッシング方法。
【請求項３】
前記触媒は、イオン交換体であることを特徴とする請求項２に記載のポリッシング方法。
【請求項４】
研磨面を有する研磨部材と、
被研磨材を把持し、被研磨材の被研磨面を前記研磨面に押し付ける把持装置と、
前記研磨部材及び把持装置を前記被研磨面と前記研磨面とを摺動させつつ相対移動させる移動手段と、
前記研磨部材の研磨面及び前記被研磨部材の被研磨面の間に超純水を供給する超純水供給装置と、
前記被研磨面の近傍の水中のイオンを偏在させる電界を形成する電界形成手段とを有することを特徴とするポリッシング装置。
【請求項５】
前記電界形成手段は、電圧を制御することによりイオンの濃度を調整することを特徴とする請求項４記載のポリッシング装置。
【請求項６】
定盤と、該定盤の取付面に取り付けられる水の解離を促進させる触媒と、該解離促進部材の他面に取り付けられる研磨部材と、前記定盤に通電する通電手段とを有することを特徴とする研磨工具。
【請求項７】

研磨に際して被研磨材と接触することによって被研磨材を研磨する研磨部材であって、前記研磨部材の少なくとも一部がイオン交換体を含む又はイオン交換体からなる通水性を有する素材で形成されていることを特徴とする研磨部材。

【請求項８】

被研磨材を研磨する研磨部材であって、前記研磨部材は、イオン交換体を含む素材とイオン交換膜が積層されて構成されていることを特徴とする研磨部材。

【請求項９】

研磨面が形成され、通水性を有する研磨部材と、

被研磨材を把持し、被研磨材の被研磨面を前記研磨面に押し付ける把持装置と、

前記研磨部材及び前記把持装置を前記被研磨面と前記研磨面とを互いに摺動させつつ相対移動させる移動手段と、

前記研磨部材から被研磨材の被研磨面へ研磨液を供給する研磨液供給装置と、

前記被研磨面の近傍の研磨液中のイオンを偏在させる電界を形成する電界形成手段とを有することを特徴とするポリッシング装置。

【請求項１０】

前記研磨液は、純水と砥粒を懸濁させたものであることを特徴とする請求項９載のポリッシング装置。

【請求項１１】

前記研磨部材は、イオン交換体からなる素材と、イオン交換膜が積層されていることを特徴とする請求項９又は１０記載のポリッシング装置。

【手続補正２】

【補正対象書類名】明細書

【補正対象項目名】０００６

【補正方法】変更

【補正の内容】

【０００６】

【課題を解決するための手段】

請求項１に記載の発明は、被研磨材の被研磨面と研磨部材の研磨面の間に超純水を供給しつつ、前記被研磨面の近傍に所定の電界を形成して水中のイオンを前記被研磨面の近傍に偏在させながら前記被研磨面と前記研磨面を互いに摺動させることにより、前記被研磨面を化学機械的に研磨することを特徴とするポリッシング方法である。

【手続補正３】

【補正対象書類名】明細書

【補正対象項目名】０００８

【補正方法】変更

【補正の内容】

【０００８】

請求項２に記載の発明は、前記被研磨面に対向して、水の解離を促進して前記被研磨面近傍のイオンを増加させる触媒を含む部材が配置されていることを特徴とする請求項１に記載のポリッシング方法である。このような触媒を含む部材としては、イオン交換膜やイオン交換不織布のようなイオン交換体を含む素材や、イオン交換体からなる素材が好適である。ここで水の解離を促進する触媒とは、超純水を汚すことなくイオンを増加させる作用がある水の解離促進部材のことである。

【手続補正４】

【補正対象書類名】明細書

【補正対象項目名】００１１

【補正方法】変更

【補正の内容】

【００１１】

請求項４に記載の発明は、研磨面を有する研磨部材と、被研磨材を把持し、被研磨材の

被研磨面を前記研磨面に押し付ける把持装置と、前記研磨部材及び把持装置を前記被研磨面と前記研磨面とを摺動させつつ相対移動させる移動手段と、前記研磨部材の研磨面及び前記被研磨部材の被研磨面の間に超純水を供給する超純水供給装置と、前記被研磨面の近傍の水中のイオンを偏在させる電界を形成する電界形成手段とを有することを特徴とするポリッシング装置である。

請求項５に記載の発明は、前記電界形成手段は、電圧を制御することによりイオンの濃度を調整することを特徴とする請求項４記載のポリッシング装置である。

【手続補正５】
【補正対象書類名】明細書
【補正対象項目名】００１２
【補正方法】変更
【補正の内容】
【００１２】

請求項６に記載の発明は、定盤と、該定盤の取付面に取り付けられる水の解離を促進させる触媒と、該解離促進部材の他面に取り付けられる研磨部材と、前記定盤に通電する通電手段とを有することを特徴とする研磨工具である。

【手続補正６】
【補正対象書類名】明細書
【補正対象項目名】００１３
【補正方法】変更
【補正の内容】
【００１３】

請求項７に記載の発明は、研磨に際して被研磨材と接触することによって被研磨材を研磨する研磨部材であって、前記研磨部材の少なくとも一部がイオン交換体を含む又はイオン交換体からなる通水性を有する素材で形成されていることを特徴とする研磨部材である。このような素材としては、例えば、グラフト重合、放射線グラフト重合等の方法で繊維状に作製されたイオン交換体不織布が好適に用いられる。

請求項８に記載の発明は、被研磨材を研磨する研磨部材であって、前記研磨部材は、イオン交換体を含む素材とイオン交換膜が積層されて構成されていることを特徴とする研磨部材である。

請求項９に記載の発明は、研磨面が形成され、通水性を有する研磨部材と、被研磨材を把持し、被研磨材の被研磨面を前記研磨面に押し付ける把持装置と、前記研磨部材及び前記把持装置を前記被研磨面と前記研磨面とを互いに摺動させつつ相対移動させる移動手段と、前記研磨部材から被研磨材の被研磨面へ研磨液を供給する研磨液供給装置と、前記被研磨面の近傍の研磨液中のイオンを偏在させる電界を形成する電界形成手段とを有することを特徴とするポリッシング装置である。

請求項１０に記載の発明は、前記研磨液は、純水と砥粒を懸濁させたものであることを特徴とする請求項９載のポリッシング装置である。

請求項１１に記載の発明は、前記研磨部材は、イオン交換体からなる素材と、イオン交換膜が積層されていることを特徴とする請求項９又は１０記載のポリッシング装置である。

【手続補正７】
【補正対象書類名】明細書
【補正対象項目名】００１６
【補正方法】変更
【補正の内容】
【００１６】

ターンテーブル１２とトップリング１４の間には、トップリング１４側を正とする所定の電圧を付加する直流電源２０が設けられている。電源２０からの配線は、それぞれ摺動端子や内部配線を介してトップリング１４の基板取付面及びターンテーブル１２の工具取

付面を形成する定盤２２に接続されている。定盤２２の工具取付面には、水の解離を促進する触媒としてイオン交換膜２４が貼付され、さらにその上面に研磨クロス１０が貼付されている。これらのイオン交換膜２４とクロス１０で研磨部材が構成されている。

【手続補正８】
【補正対象書類名】明細書
【補正対象項目名】００３０
【補正方法】変更
【補正の内容】
【００３０】

また、上記においては、研磨液をターンテーブル１２側から供給する内部給水方式を採用し、砥粒は用いていないが、図５に示すような研磨砥液ノズル１６からの外部給水方式も研磨条件に応じて採用することができ、この場合は砥粒を用いても良い。砥粒を用いる場合も、従来のようなＫＯＨベースのスラリーは用いずに、純水中にＳｉO_2粒子などの砥粒を懸濁させたものを用いる。砥粒を介在させることにより、機械的作用が促進され、研磨速度が増す。